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# AN INVESTIGATION OF INTEGRATED PRODUCT DEVELOPMENT: A CASE STUDY OF AN F-22 PRIME CONTRACTOR

THESIS

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# AN INVESTIGATION OF INTEGRATED PRODUCT DEVELOPMENT: A CASE STUDY OF AN F-22 PRIME CONTRACTOR

THESIS

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Stephanie Lopez

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## Abstract

This research investigates the effects of implementing the Integrated Product Development (IPD) philosophy in a major acquisition program, specifically an F-22 Advanced Tactical Fighter Prime Contractor's IPD implementation.

The population of the study consists of employees of the prime contractor working directly with IPTs on the F-22 program. A survey with closed-ended questions and open ended statements was used to collect the data. The survey was pretested on F-22 SPO personnel to increase survey reliability.

Survey results indicate that this prime contractor is having difficulty implementing IPTs. The IPT structure in this company does not seem to have improved the ability of company personnel to contribute to the success of the F-22 program.

Research indicates that the company should firmly establish its commitment to product teams and clearly define the roles of functional area managers and IPTs. Team leaders could better communicate with team members about critical issues and decisions. Improved training could alleviate many of the company's problems implementing IPTs. Finally, communication should improve. IPTs can be most effective when communication is frequent and effective.

# AN INVESTIGATION OF INTEGRATED PRODUCT DEVELOPMENT: A CASE STUDY OF AN F-22 PRIME CONTRACTOR

## I. Introduction

### General Issue

The new Department of Defense "5000 Series" documents provide the basic guidelines and policies to be used in the management of defense acquisition programs (7:4). The manner in which these guidelines and policies are implemented at the program level is varied and in a state of change. The declining defense budget and increased scrutiny of recent defense acquisition programs such as the A-12, B-2, and C-17 has forced the Department of Defense to change the way it has traditionally developed and acquired new weapon systems.

One of the biggest changes that has taken place has been the implementation of Integrated Weapon System Management (IWSM). Part of this management philosophy, that takes place during weapon system development and procurement, is Integrated Product Development (IPD), which transforms the traditional organizational management structure into Integrated Product Teams (IPT) (4:18). An IPT is a group of people, brought together to perform a specific task or group of tasks, and comprised of all those with the expertise necessary to complete the task or tasks in the most expeditious and effective manner. IPTs are one of the means by which the Air Force intends to reduce cost, achieve technological improvements, and improve the quality of its weapon systems.

This research examines the implementation of IPTs at an F-22 prime contractor in order to determine if this contractor has implemented its IPTs in the most effective manner. Based upon the results of this research, recommendations are made to improve this contractor's IPT implementation

After reviewing three theses (13; 16; 20) that studied IPTs, the researcher decided to focus on the F-22 System Program Office. This is the office responsible for the overall

management of the F-22 Advanced Tactical Fighter program, including development, acquisition, sustainment, and disposal. The F-22 program was chosen for several reasons. First, it was the first major weapon system acquisition in the Air Force to implement the IPT concept. Secondly, it has several of the biggest defense contractors in the United States on the program. Finally, it has the most experience (within the Air Force) in implementing and operating within the IPD concept.

The review of the previously mentioned three theses also helped further reduce the scope of this research. Two of the three theses directly studied the F-22 SPO implementation of IPTs. One thesis suggested that the F-22 contractors should be researched to provide insight into how they are implementing IPD and to analyze the effects on the program due to this new management philosophy (20:5-6). The other thesis expressed concern because a significant number of F-22 SPO personnel perceived that the contractors were not totally committed to operating in a team structure (13:59). These theses led the researcher to select a prime contractor as the focus of this study.

## Purpose

This research provides a case study of a prime contractor who gave approval to perform research under the condition that the company's name be withheld and analyzes the effects of IPTs on the contractor and the program. In addition, this study investigates the contractor's implementation methods within the F-22 acquisition program and provides the Air Force with lessons learned for use in future acquisition programs. The research identifies positive and negative effects and recommends possible changes in IPT implementation to maximize its benefits.

The research objectives of this study are to: (1) determine how the prime contractor has implemented IPTs as compared to the F-22 IPT guidelines for implementation; (2) identify aspects of the prime contractor IPT structure that have

positive and/or negative effects on personnel and the program; (3) analyze the positive and negative effects of prime contractor IPT implementation and identify possible corrective actions to help the contractor and F-22 program operate in the most effective organizational structure.

Methodology

Based on previous research, it is reasonable to believe that the F-22 SPO has achieved a relatively smooth transition to the IPT concept and has overcome most of the transition problems. Because of this belief, the F-22 IPD Implementation Guide was selected as the standard against which the prime contractor would be evaluated. The IPD Implementation Guide contains ten investigative questions designed to determine how IPTs were implemented and what improvements to the IPT structure can be made. These questions are:

1. How is the contractor physically structured, before and after implementing IPTs?
2. How does the structure compare to the F-22 SPO structure?
3. How critical is it that the contractor's IPT structure be the same as the SPO?
4. What kind of transitional problems were encountered and how were they overcome?
5. What kind of communication techniques are used within the contractor and between the contractor and the SPO?
6. What kind of integrated management tools are used and are they more effective than management tools used on past programs?
7. If there are improvements in the management of the program, are they due to new advanced technology, IPTs, or both?
8. What kind of IPT training was given to employees?

9. Has the decision making process changed and empowered IPTs at the lowest level to make decisions?

10. What does the contractor recommend currently and for future programs in order to implement IPTs in the most productive structure?

From these questions, the researcher developed a questionnaire with twelve closed-ended statements and four open-ended questions. These statements and questions were designed to specifically determine how IPTs had been implemented at the prime contractor and what team members felt could be done to improve the current IPT structures.

This survey was then pretested with F-22 SPO personnel and the results of the survey along with personal interviews were used to improve the survey. Improvements were made to ensure clarity of the statements and questions and to ensure that the intent of the statements and questions was easily understood. The survey was again pretested with F-22 SPO personnel and determined ready for distribution to the study subjects.

Based upon the previous research and the concerns of the prime contractor, it was anticipated that: (1) the prime contractor has not implemented the IPT concept in the most efficient manner; (2) there are key areas of program management at the prime contractor that are being negatively impacted by the current IPT structure; and (3) corrective actions can be recommended that will benefit the prime contractor and the F-22 program if implemented.

## Limitations

There are three limitations. The first limitation is that this research does not attempt to define what each organization's IPT structure should be since each program's implementation is different, based on its size, existing structure, and resources. The second is that this study will perform an analysis to determine what IPT implementation

techniques work and do not work for this prime contractor only. The final limitation is the acquisition phase studied will include Engineering, Manufacturing, & Development on the F-22 program only. This is a critical phase in the acquisition process which created significant time constraints on contractor personnel.

Thesis Overview

The remainder of this thesis provides a summary of related research on product team background and measurement (Chapter II). It will also include details of the research design methodology and survey instrument (Chapter III). In addition, there will be an analysis of the F-22 prime contractor IPT member responses to the survey (Chapter IV). Finally, this thesis will arrive at conclusions and recommendations both for the F-22 prime contractor and for use in future research and acquisition applications (Chapter V).

# II. Literature Review

## Introduction

This chapter will present the basic concepts of IPD and IPTs. It is important to understand these concepts to determine how the prime contractor has implemented its IPTs. Problems with prime contractor IPT implementation directly affect the performance of the F-22 SPO and the quality and timeliness with which the acquisition of the F-22 aircraft can be accomplished. Understanding these concepts will also assist the reader to understand how the investigative questions were selected and provide insight into why the survey statements and questions were designed as they were. To that end, this chapter provides background on the IPD philosophy and how the DOD has transformed its acquisition process to accommodate the new management style. The literature review also documents the evolution of IPD to include concurrent engineering, the Air Force and prime contractor implementation of IPD, and IPT characteristics.

## IPD Background

Integrated Product Development is a philosophy. It is not something that can be touched or seen. It is a deliberate thought process and an attitude toward building a product for a customer (1:v). IPD is defined as:

> A philosophy that systematically employs a teaming of functional disciplines to integrate and concurrently apply all necessary processes to produce an effective and efficient product that satisfies the customer's needs (6:v).

Unlike traditional, vertical management structures that segregate functional responsibilities, the major tenet of IPD is to integrate all of the functional expertise into Integrated Product Teams, that are multi-functional and formed for the specific purpose of delivering a total product that will satisfy the customer (4:18). These teams also normally

include multi-functional subsystem product development teams with manufacturing, logistics, testing, and support personnel consistent with the IPD philosophy (3:29).

Although the IPT is not the end goal of IPD, it is the major tool used to integrate and develop a product through teamwork. IPTs can be implemented at all levels of an organization, from the top level of an organizational structure to an informal "Tiger Team" established to solve a specific problem. In the IPT environment, team members will interact and focus on the product's overall system performance rather than on individual subsystem performance (5:18-19).

The concept of teamwork is intended to develop a set of skills in the members. Some of these learned skills are listening and responding in a constructive way , supporting other team members, recognizing their interests and achievements, and making decisions based on consensus. The relationship develops because "consensus solutions" eliminate the confusion over the team's purpose and eliminate the need to use the chain-of-command to resolve conflicts or make decisions (5:18).

Evolution of IPD

Not a new idea, IPD actually got its start in the Japanese automobile industry following World War II. In the beginning, the Japanese developed IPD to emphasize building a more efficient product by improving the product development process. For example, manufacturing people were brought into the development process early so they could eliminate many of the re-engineering tasks caused by unproduceable automobile designs. This lowered costs significantly and improved the speed with which the Japanese could bring products to market. By improving the processes, the idea was that quality and productivity would improve as well. This was done by integrating the personnel, using systems engineering, planning for manufacturing in the design, and encouraging open communications. This integrated design process, sought out by U.S. industry in the early

1980s to improve competitiveness in the market, is known as Concurrent Engineering (21:2-3). Concurrent engineering is defined as:

> a systematic approach to the integrated concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause developers, from the onset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements (14:v).

Concurrent engineering is the basic building block from which IPD evolved. The Air Force expanded the concepts of concurrent engineering to include all disciplines and functional elements that are essential to a successful program, not just the engineering aspects.

Air Force Implementation of IPD

In 1986, the Under Secretary of Defense for Acquisition (USD(A)) recognized the need for change in the processes used in defense acquisition. The USD(A) requested that the Institute for Defense Analysis investigate concurrent engineering concepts that were applicable to DOD procurement programs. The IDA report (14:v) recommended that concurrent engineering practices be applied to DOD acquisition processes, with an emphasis on multi-disciplined teams being implemented for product development. This recommendation created a need to rewrite DOD acquisition policy guidelines to emphasize a management philosophy that was focused on meeting the customer's needs (21:2-3).

The Air Force Materiel Command (AFMC) recognized the benefits of implementing this new philosophy and General Yates, AFMC commander, published a white paper (2) endorsing the IPD concept and directing that it be implemented fully by October 1993. One of the first programs to implement IPD was the F-22. The F-22 Program Manager at that time was Colonel Fain. Colonel Fain was given a directive by

the Pentagon to "bring a standard of excellence to military procurement." No other instructions were given other that "just do it" (7:50-51). He then implemented the first version of IPD in a major weapon system acquisition program throughout the SPO and contractor teams.

IPT Characteristics

The purpose of an IPT is to bring together all the essential functions necessary to make quick and effective decisions that affect the overall product. There is no ideal structure that will fit each organization, but understanding the key characteristics of an IPT will help in structuring an organization to reap the most benefits. The key characteristics of an IPT are (5:18-20):

- Team is set up to produce a specific product or service;
- Multi-disciplinary - all team members/functions working together towards a common goal;
- Members have mutual, as well as individual accountability;
- Integrated, concurrent decision making;
- Empowered, within specific product or service goals, to make decisions; and
- Planned integration among teams towards system goal.

The key to the total structure is the horizontal and vertical integration of the products and processes and among the IPTs.

In some cases, IPTs are formed for a temporary effort. An example of this would be to develop a briefing or improve a current process such as improving the time required to dispense drugs to customers at a pharmacy. IPTs normally consist of only a few people working closely together until the project is finished. This type of team is called a Tiger Team or Process Action Team. They are formed for a specific task and specific time span. When the task is completed, they are disbanded (5:19).

IPTs of a more formal nature could be Program Offices, Product Group Managers, and Materiel Group Managers. These organizational IPTs are normally comprised of

several IPTs addressing several different components that comprise the total product. In this hierarchical IPT structure, the system is the top-level item to be produced for the customer. One example of teamwork being used to develop a product is the Neon automobile. Under this top-level group, the system is divided into various functional IPTs that, when integrated, form a total system. Examples of this would be IPTs responsible for the transmission, chassis, etc. The demographics of each team at each level should involve all those who are affected by the product or process the team is working on such as manufacturing, engineering, logistics, testing, and support personnel. Each IPT has specific responsibilities for their product/process that must be coordinated with the other teams in that organization.

The risk associated with a product, such as high cost, technological complexity, or compressed delivery schedule, will determine how many levels of IPTs are required. The higher the risk, the more levels of IPTs are usually required to assure success. Every IPT has a customer and is responsible for delivering a product to that customer. For lower level IPTs, that customer is the next higher level of IPT in their chain-of-command (See Figure 2). The amount of success achieved under this structure is dependent upon the horizontal and vertical integration of the products/processes between IPTs (5:19).

The focus of the IPT is to optimize the product while remaining within the team's defined responsibilities. This is achieved by fully involving those functional skills necessary and using those inputs in an integrated decision-making process. Effective teams are the backbone of a high quality organization (4:20).

Roles and Responsibilities

Team member selection is critical and should be based on the characteristics of the product cost, performance goals, and risk. A team may vary in size or composition depending on what phase of the life cycle the product is in at the time. It is also important

that the team be made up of individuals at the right functional level. For example, leadership probably would not ask a team working on a specific product such as a starter for an automobile to establish broad program policy. Instead, this type of team would likely consist of managerial personnel (5:22).

There are two types of team members: core and part-time members. Core members participate on a full-time basis, while part-time members are called upon only when needed. Core members are selected based on production risks such as product cost, technological complexity, or compressed delivery schedule, as well as by the amount of work required of them. Part-time members are selected based mainly on personnel availability and/or small workload. The team leader determines team composition based on the areas which present the most risk to the success of the team (5:22).

Ideally, team members should be co-located geographically to enhance communication. This is not always possible because a member may be on more than one team or may be geographically separated (5:22). Using team members on more than one team should be avoided if at all possible. It has been shown that companies that innovate most successfully limit their team members to one major effort at a time (19:108).

Successful IPTs have team leaders. Team leaders keep their teams focused. Qualities effective team leaders share include the following:

1) The team leader must be a team player with good leadership attributes and ability to guide the team's operation.
2) The team leader must have good communication skills.
3) The team leader should have a broad knowledge base and be familiar with the various functional aspects that affect the performance of the team product.

The team leader may or may not supervise members of his or her team. If the team leader is the supervisor, he or she will perform the normal supervisory duties (e.g. performance appraisals, work assignment, etc.) (3:23). If the team leader is not the

supervisor of the individuals on the team, he or she must provide inputs to the functional staff leader for training and appraisal evaluations.

Traditional SPO Structure

The traditional SPO organizations are functional organizational structures or "vertical chart" organizations headed by the Program Manager, who is responsible for all decisions made in the program (6:v). As can be seen in Figure 1, he or she is normally supported by eight different functional directorates with separate responsibilities.

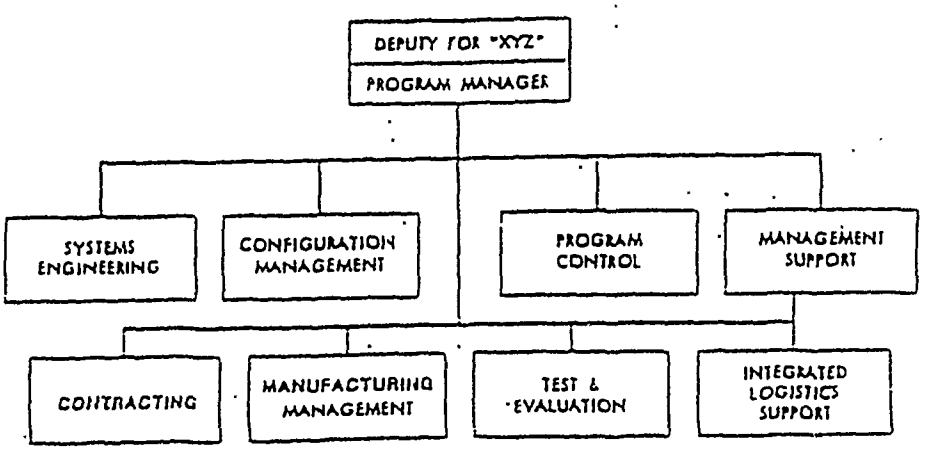



Figure 1. Traditional SPO Organization

Each directorate is responsible for its particular activity only and for advising the Program Manager on its functional area of expertise. For example, whereas Systems Engineering is responsible for the technical direction of the program, the Contracting Directorate is responsible only for the acquisition activities of the program. The only place that the directorates interface is at the PM level, which limits the ability of the individual members in each directorate to effectively interface and work out problems.

This traditional structure presents ample opportunity for isolating functional directorates and narrowing responsibilities when crucial decisions are being made during

the different phases of an acquisition program. The effect of this natural barrier, inherent in the traditional structure, is that it gives no incentive at the lower levels to resolve problems with a product that resides outside the scope of the directorate. Problems that could have been resolved by having better communication and more responsibility become problems at the PM level. An example would be the re-working of parts caused by unproduceable designs that happen because the design engineers do not talk to the manufacturing people during the design process. This increases the cost of the product and slows the ability of the parties involved to bring the product to market. This is the philosophy that must change if any improvements are to be achieved in the quality and cost of weapon system acquisition programs.

Current SPO Structure

IPD was formulated to change the traditional structure and eliminate the natural barriers between the directorates in order to put responsibility for the total product at the lowest levels of the organizational structure. In Figure 2, the IPT structure of the SPO still retains the traditional functional directorates (15:v).

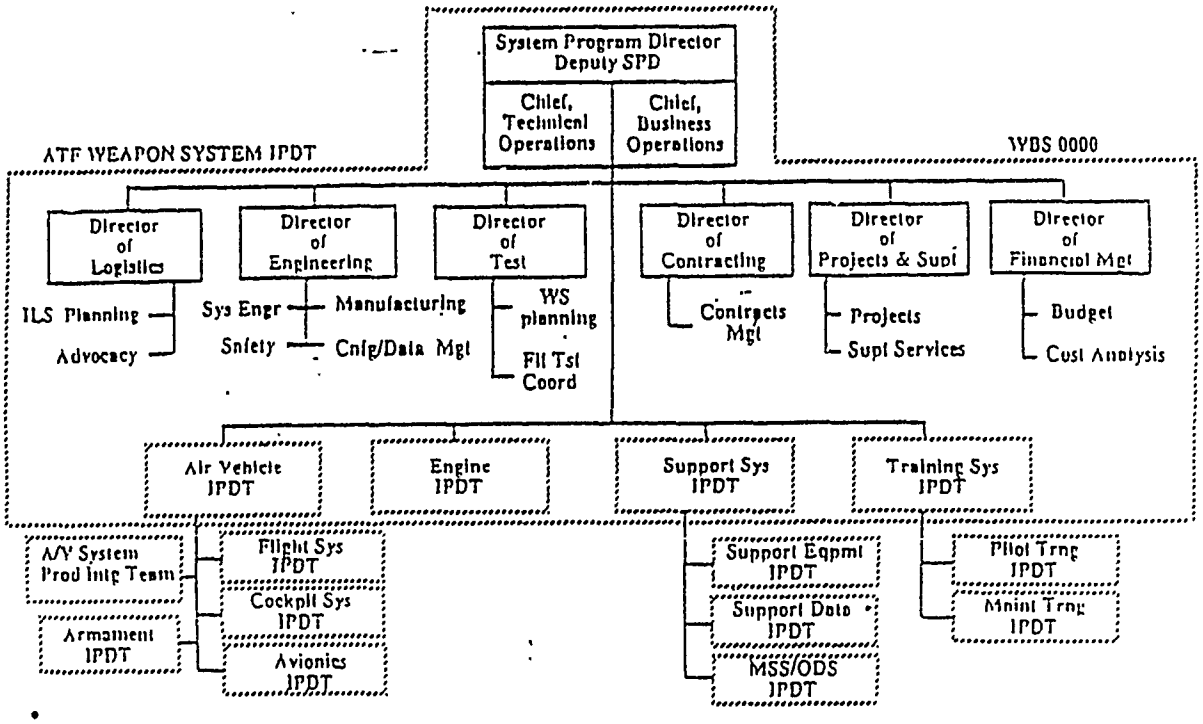



Figure 2. ATF SPO FSD Organizational Structure

The major change is the addition of various IPTs throughout the organization. The IPTs shown at the lowest levels in the figure are actually broken down further into separate IPTs for each particular function of the weapon system. For example, the Flight Systems IPT is comprised of the Electrical Power System IPT, Hydraulic System IPT, and Fuel System IPT. The important feature of this structure is the line of communication from the IPTs to the PM that is separate from the directorates. This does not relieve the functional directorates from their responsibilities. Their focus now becomes advising the PM and making policy within their respective directorates as well as providing expert personnel to various IPTs.

The IPTs consist of by personnel from each of the directorates, with the engineer for the specific IPT typically acting as the team leader. Depending upon manpower

resources, personnel from the directorates may or may not be able to physically locate themselves within the lowest level IPTs. In this case, they will locate themselves within the appropriate level IPT and then be responsible for all the subordinate IPTs within the next lower level. For example, a cost analyst or contracting officer may be assigned at the Air Vehicle level (Figure 2) and still be responsible for performing the cost analyst or contracting duties at the Flight Systems level (15:v).

The IPT leader is responsible for the total product that he or she manages. This person has the resources of all the directorates available on his or her team and thus, there should be no communication gaps to cross in order to solve a problem. The IPT leader is, in effect, a program manager for his or her portion of the total product (3:29).

The IPT structure is intended to increase the effectiveness of the traditional structure by eliminating barriers to communication and decision making. Instead of information flowing to the top of the decision-making tree without any solutions attached, the lower level IPTs would make the decisions and recommendations that would then be flowed upward for approval. This approach builds team ownership of a product and the incentive at the lower levels to look at the performance of the product as a whole. With this type of involvement early in an acquisition program, one can resolve and eliminate typical problems that tend to plague a program in the latter phases of the acquisition cycle (3:30).

F-22 Prime Contractor IPT Structure

The traditional contractor organizations are very similar to the Air Force SPO organizations and follow the same structure shown in Figure 1. Figure 3 shows how all the prime contractors are now organized in an IPT structure from Tier I to Tier III similar to the F-22 SPO organizational structure (12:v). The Tiers employed by these contractors are hierarchical like those used in the F-22 SPO. Figure 4 shows a breakdown from the

Tier II IPTs to the Tier III IPTs (12:v). Figure 5 shows how the prime contractor has organized to accommodate IPTs (12:v). A comparison of Figure 2 and Figure 5 shows the difference in the way the F-22 SPO and the prime contractor have set up their IPT structures.

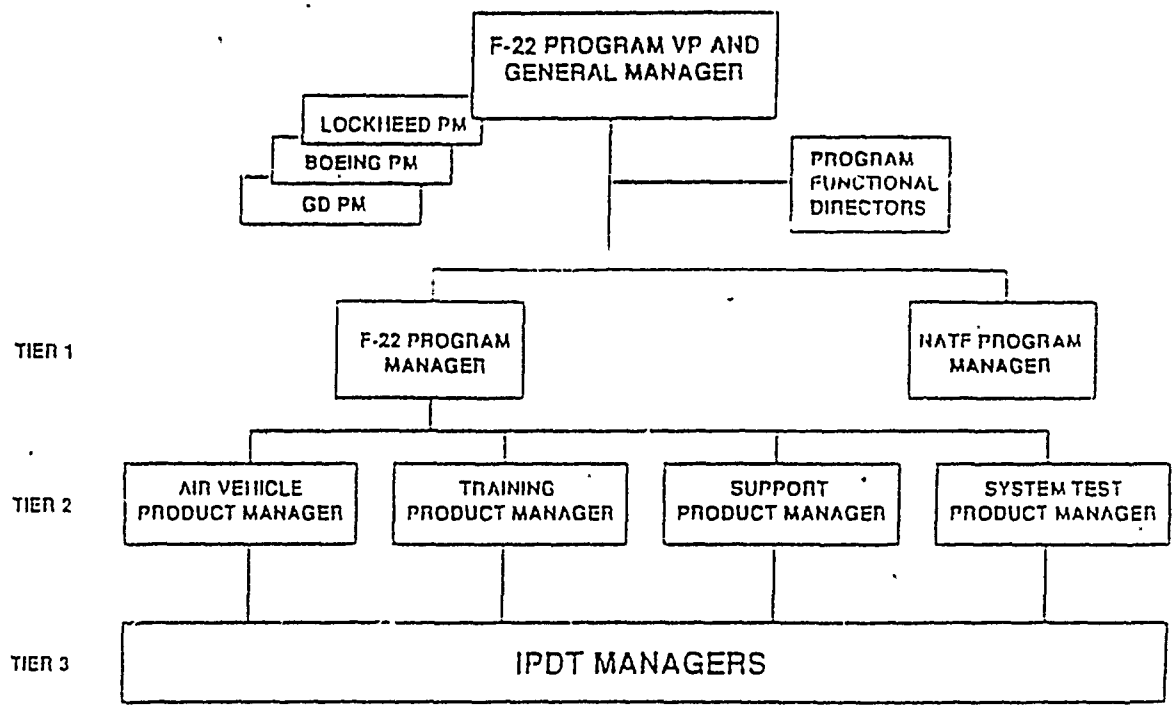



Figure 3. IPD Organization Retains Clear Line of Responsibility and Authority

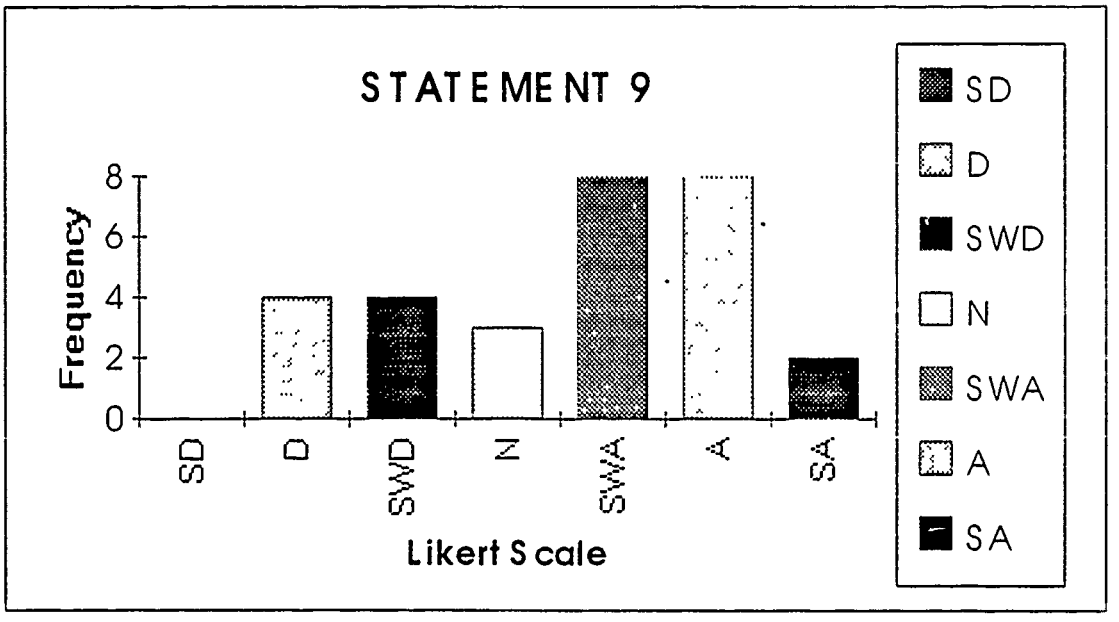
Air Force documentation states it is important to "match" government and contractor IPTs (6:35). While this is being accomplished on paper, the actual implementation does not accomplish the necessary matching. Those individuals who head the product management areas are in charge of program direction whereas the individuals in charge of operating functions control all the resources and expertise. This means that

would create difficulties with communication and coordination between teams and organizations because there would be no obvious counterpart. There were some who disagreed that team structures should be the same (14%). One respondent stated that team structure "needs to consider the differences in local management organizational structure." It would seem that this individual may not have abandoned the traditional hierarchical management structure.

Statement 9.

MY IPT LEAD MAKES DECISIONS BASED ON TEAM DISCUSSIONS AND CONSENSUS.

Mean Response: 4.28 (Closest to Neutral)




This statement was designed to determine the IPT leader's decision making style. The response to this statement was positive (66%) for the most part. The majority of the respondents felt that their IPT leader valued their opinions when making decisions. It appears that IPTs generally have good communication and teamwork between the leader and members. However, there was significant disagreement on this statement (28%). One

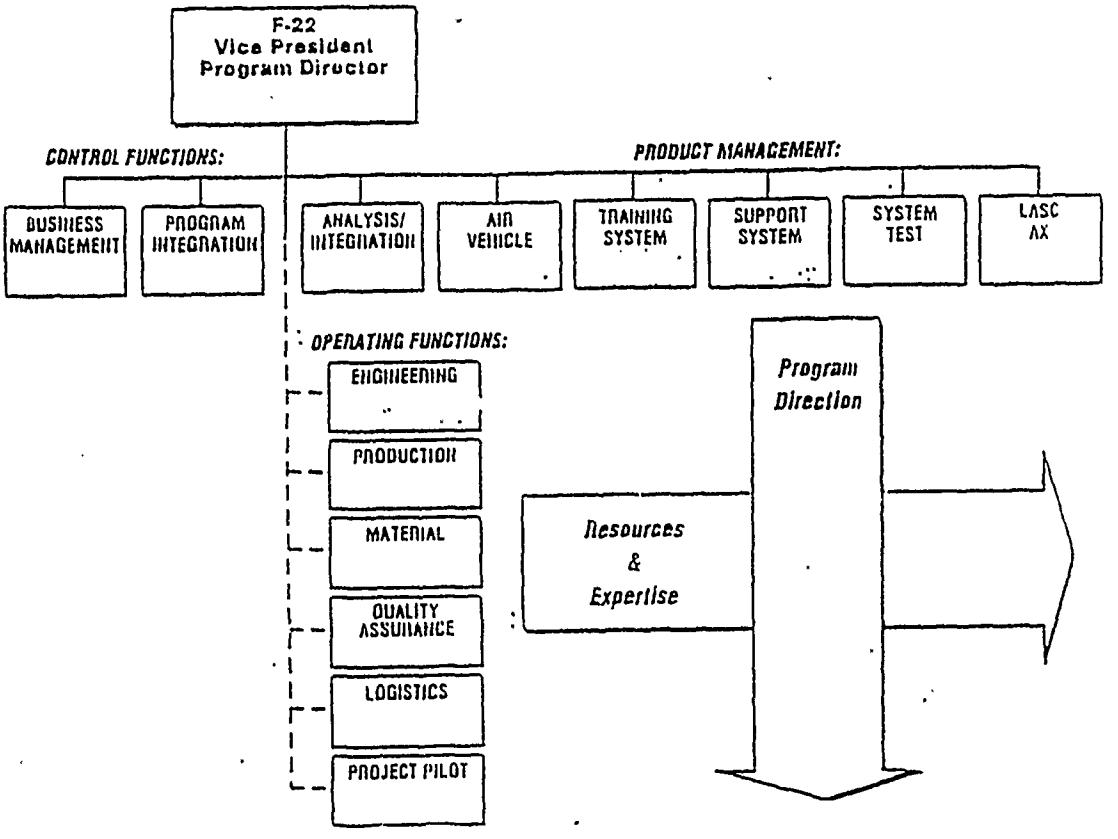



Figure 5. Prime Contractor Organization

Summary

This literature review provided the basic background behind the IPD philosophy and how it has evolved from early concurrent engineering practices in civilian industry. The review also reveals how the DOD, Air Force, and F-22 program implemented IPD and how it affects the organizational structure of a program. Traditional and IPT structured organizations were compared and the aspects of both styles of management were detailed. The overall purpose of changing the DOD acquisition process was to build a better product for the customer. The basic vehicle for doing this was the development of IPTs with the purpose of integrating all the expertise within the organization needed to

Understanding and implementing IPD correctly is very important for all of the DOD and civilian contractor acquisition communities. DOD and Air Force leadership has embraced IPD and directed full implementation. If we are to reap the benefits of this philosophy, we must understand why it works and how to apply it correctly.

# III. Methodology

## Introduction

The methodology employed in this chapter was developed to: (1) determine how the prime contractor has implemented IPTs as compared to the F-22 IPT guidelines for implementation; (2) identify aspects of the prime contractor IPT structure that have positive and/or negative effects on personnel and the program; and (3) analyze the positive and negative effects of prime contractor IPT implementation and identify possible corrective actions to help the contractor and F-22 program operate in the most effective organizational structure.

Previous research has shown that the F-22 SPO has overcome most of the transitional problems and has made the transition to the IPT concept. For this reason, the F-22 IPD Implementation Guide as selected as the standard against which the prime contractor would be evaluated. This guide contains ten questions designed to determine how IPTs were implemented and what areas can be improved. These questions identify key areas that are critical to creating a successful product. These investigative questions are:

1. How is the contractor physically structured, before and after implementing IPTs?
2. How does the structure compare to the F-22 SPO structure?
3. How critical is it that the contractor's IPT structure be the same as the SPO?
4. What kind of transitional problems were encountered and how were they overcome?
5. What kind of communication techniques are used within the contractor and between the contractor and the SPO?

6. What kind of integrated management tools are used and are they more effective than management tools used on past programs?
7. If there are improvements in the management of the program, are they due to new advanced technology, IPTs, or both?
8. What kind of IPT training was given to employees?
9. Has the decision making process changed and empowered IPTs at the lowest level to make decisions?
10. What does the contractor recommend currently and for future programs in order to implement IPTs in the most productive structure?

The survey was personally distributed by the researcher to sixty individuals at the prime contractor so the researcher could complete the research data and validate the research objectives. Of the 60, 29 participated for a response rate of approximately 50%. Once the data was tabulated in raw form, the mean, median, and mode were calculated for each question and a determination of the answer was made. A graphical presentation was also made of the raw and analyzed data. The qualitative data was used to support and/or explain the analyzed quantitative data and to give insight on the attitudes of the respondents. The results of the survey will be used to provide possible corrective actions to the prime contractor and enhance future DOD acquisition programs, helping others to avoid the mistakes and benefit from the successes of this F-22 prime contractor.

This research was performed based on three assumptions. These assumptions are: (1) that the prime contractor has not implemented the IPT concept in the most efficient manner; (2) that there are key areas of program management at the prime contractor that are being negatively impacted by the current IPT structure; and (3) that corrective actions can be recommended that will benefit the prime contractor and the F-22 program if implemented.

Research Instrument Design

From the ten investigative questions, the researcher developed a survey which consists of twelve closed-ended statements and four open-ended questions. The researcher designed this survey to determine how the prime contractor had implemented IPTs and how team members feel the current IPT structure could be improved (See Appendix A).

A questionnaire in the form of a Likert scale was used as a pretest with selected F-22 SPO personnel. The test was administered by the researcher and scrutinized for ambiguous questions to ensure that the questionnaire was complete. The personnel were also asked to provide additional suggestions on how to improve the questionnaire. The questionnaire was then rewritten and administered to a proportional sample of personnel at the prime contractors facility.

The survey raw data was categorized by statement number, number of responses, and strength of response. The possible statement answers were: (1) strongly disagree; (2) disagree; (3) somewhat disagree; (4) neutral; (5) somewhat agree; (6) agree; (7) strongly agree.

Population

The population used in this study consisted of approximately 200 potential subjects employed by the prime contractor who work directly with IPTs on the F-22 program. Of these 200 employees, 60 were selected as the target sample for the study. The population includes employees at different levels in the IPT management chain. There are typically five levels/tiers on the F-22 program, with Level I/Tier I being the highest level and Level V/Tier V being the lowest.

Sampling Bias

Some bias may be expected because the sample was limited to a single Tier III IPT and its subordinate IPTs. There was a significant disparity in the response rates of the Tier III IPT (10%) and the Tier IV IPTs (90%). This caused the responses to more accurately reflect only one level (Tier IV) of the IPTs at this prime contractor, rather than presenting a representative or proportional result. The low return rate of 50 percent (29 responses) does not present a true representation of overall contractor IPTs.

Sample Selection

The research sample is focused on one of the Prime Contractor's Tier III IPTs and the ten Tier IV IPTs over which it has management control. The sample consists of 60 personnel currently working at two levels within the IPT structure. The individuals were selected based on their position in the IPTs and work experience to ensure a good cross-section of experience. This included administrative, managerial, and functional personnel. It also included a wide range of years on the job. For example, a person who has worked for the company for twenty years could be resistant to change, but should also have more expertise than someone with less time with the company. The researcher also assumed that a person in a higher tier should have more experience because it normally takes time and experience to rise in the corporate structure.

Reliability

The researcher performed careful documentation of statement development and used several variations of the same statement to determine the consistency of responses. The surveys were developed after interviews with F-22 SPO personnel. This helped reduce flaws in the statements and questions and clarified the data being obtained. Pre-testing of the questions by knowledgeable personnel from the F-22 SPO also increased the

overall reliability of the instrument. The availability of knowledgeable personnel to interview and survey was more than adequate given the researcher's time constraints and contractor's scheduling commitments. There was a large population from which to both pre-test and collect target data. The researcher attained a 50 percent return rate. This low return rate was attributed to time constraints for the researcher, limitations of the prime contractor availability due to schedule commitments, and because some respondents were fearful of repercussions.

Validity

Due to the large size of the study population, approximately 200 contractor personnel, the researcher took representative samples from the Tier III IPT and several different Tier IV IPTs in the same ratio at each location. This allowed a variety of data collection points and provided a broader base of data. However, the low response rate (20 responses) does not allow the researcher to assume that the conclusions derived from the research can be applied throughout the company. The validity of responses across IPTs was satisfactory, encompassing managerial, administrative, and functional personnel. The low response rate from the Tier III IPT of 10 percent makes the data strongly favor the Tier IV IPTs which had a 90 percent response rate.

Summary

This methodology was developed to: (1) determine how the prime contractor had implemented its IPTs; (2) determine the positive and negative aspects of contractor IPT implementation; and (3) allow the researcher to analyze the positive and negative effects to identify possible corrective actions.

The F-22 implementation guide was used as the standard against which to measure. The survey was developed, distributed, collected, and analyzed by the researcher. Sixty surveys were distributed and 29 surveys were returned.

The majority of surveys (90%) returned were accomplished by the Tier IV IPTs. This made the validity of the research suspect as the researcher could not apply the conclusions across the entire company.

# IV. Data Analysis

## Introduction

The survey was administered to individuals at the prime contractor to: (1) determine how the prime contractor has implemented IPTs as compared to the F-22 IPT guidelines for implementation; (2) identify aspects of the prime contractor IPT structure that have positive and/or negative effects on personnel and the program; and (3) analyze the positive and negative effects of prime contractor implementation and identify possible corrective actions to help the contractor and F-22 program operate in the most effective organizational structure. The survey was based on the investigative questions identified in the F-22 IPD Implementation Guide which are:

1. How is the contractor physically structured, before and after implementing IPTs?
2. How does the structure compare to the F-22 SPO structure?
3. How critical is it that the contractor's IPT structure be the same as the SPO?
4. What kind of transitional problems were encountered and how were they overcome?
5. What kind of communication techniques are used within the contractor and between the contractor and the SPO?
6. What kind of integrated management tools are used and are they more effective than management tools used on past programs?
7. If there are improvements in the management of the program, are they due to new advanced technology, IPTs, or both?
8. What kind of IPT training was given to employees?
9. Has the decisions making process changed and empowered IPTs at the lowest level to make decisions?

10. What does the contractor recommend currently and for future programs in order to implement IPTs in the most productive structure?

The survey consisted of a cover letter that explained the importance of the survey, an attachment that explained the purpose of the survey and provided detailed instructions on how to complete the survey, and the survey statements/questions (See Appendix A). This process gave the subjects some insight into the purpose of the survey and more incentive to complete it.

Survey Data

The results of the survey, listed in Table 1, are based on 29 responses. The survey statements which correspond to the statement numbers in Table 1 are:

1. I received adequate training on how the IPT concept works.
2. Communications is better under the IPT structure.
3. The use of IPT structure has not empowered teams at the lowest level to make decisions.
4. The IPT process is not working as well as it should.
5. The (contractor name removed for confidentiality) IPT structure is set up in the best possible way.
6. Management of the F-22 program is better due to IPTs.
7. Management of the F-22 program is better due to technological advances such as the VTC, better computers, etc.
8. The structure of the IPTs should be the same at all of the F-22 companies.
9. My IPT lead makes decisions based on team discussion and consensus.
10. Because of IPTs, I have a better systems perspective than on past programs.
11. I enjoy working on IPTs more than in previous organizational structures.
12. I do not believe that IPTs will lead to a better end product.

The raw data are categorized in Table 1 by (1) statement number, and (2) the number of surveys returned with each numerical response to that statement number.

Table 1. Number of Responses for Each Statement

| Statement # | Strongly Disagree | Disagree | Somewhat Disagree | Neutral | Somewhat Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1 | 3 | 5 | 5 | 1 | 7 | 7 | 1 |
| 2 | 1 | 8 | 3 | 3 | 5 | 7 | 2 |
| 3 | 0 | 4 | 5 | 5 | 2 | 12 | 1 |
| 4 | 0 | 2 | 2 | 2 | 4 | 14 | 5 |
| 5 | 5 | 7 | 4 | 5 | 4 | 4 | 0 |
| 6 | 4 | 7 | 1 | 5 | 4 | 6 | 2 |
| 7 | 0 | 2 | 1 | 4 | 8 | 10 | 4 |
| 8 | 0 | 2 | 2 | 1 | 5 | 6 | 13 |
| 9 | 0 | 4 | 4 | 3 | 8 | 8 | 2 |
| 10 | 3 | 5 | 1 | 7 | 3 | 3 | 7 |
| 11 | 2 | 2 | 2 | 6 | 3 | 11 | 3 |
| 12 | 3 | 12 | 3 | 5 | 0 | 5 | 1 |

Investigative Statements and Results

This section discusses each statement's response, inferences made from the responses, comments made by prime contractor personnel on the open-ended questions in the survey, and summarizes the results as a measure of prime contractor IPT characteristics. The open-ended survey questions are:

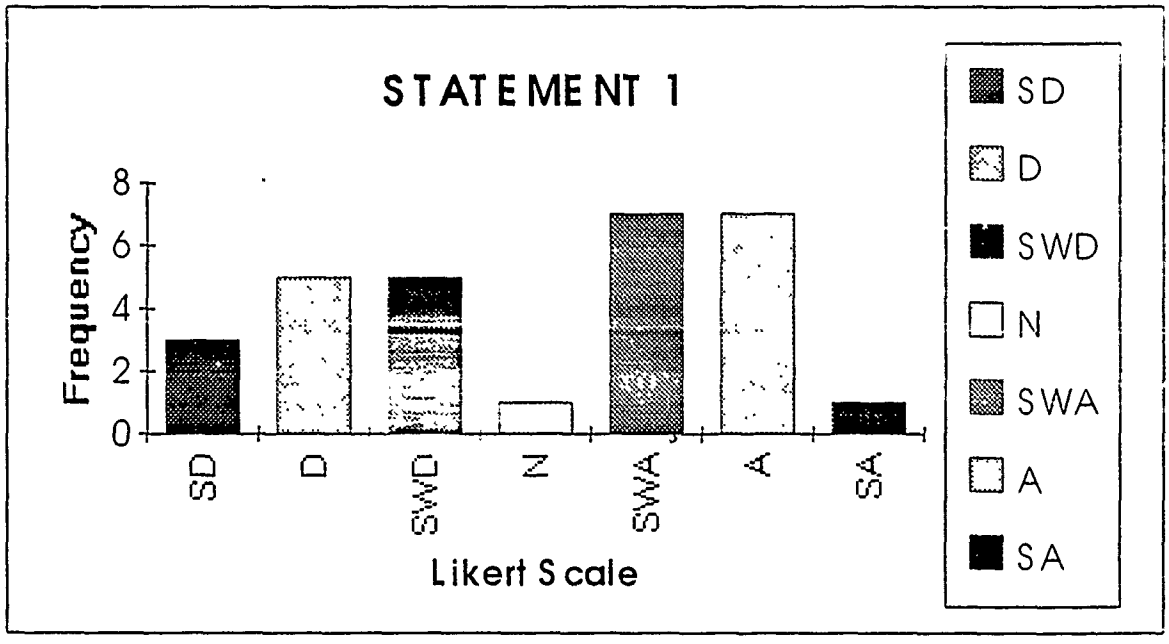
13. What were your expectations of IPTs during their establishment (pros/cons)?
14. What are your biggest issues/concerns with IPTs?
15. What benefits do you see that are related to IPTs?
16. What would you change in the current IPT structure to improve it?

The "mean response" is the weighted mean based on the number of surveys returned for the 1 through 7 response scale.

Statement 1.

I RECEIVED ADEQUATE TRAINING ON HOW THE IPT CONCEPT WORKS.

Mean Response: 4.00 (Neutral)



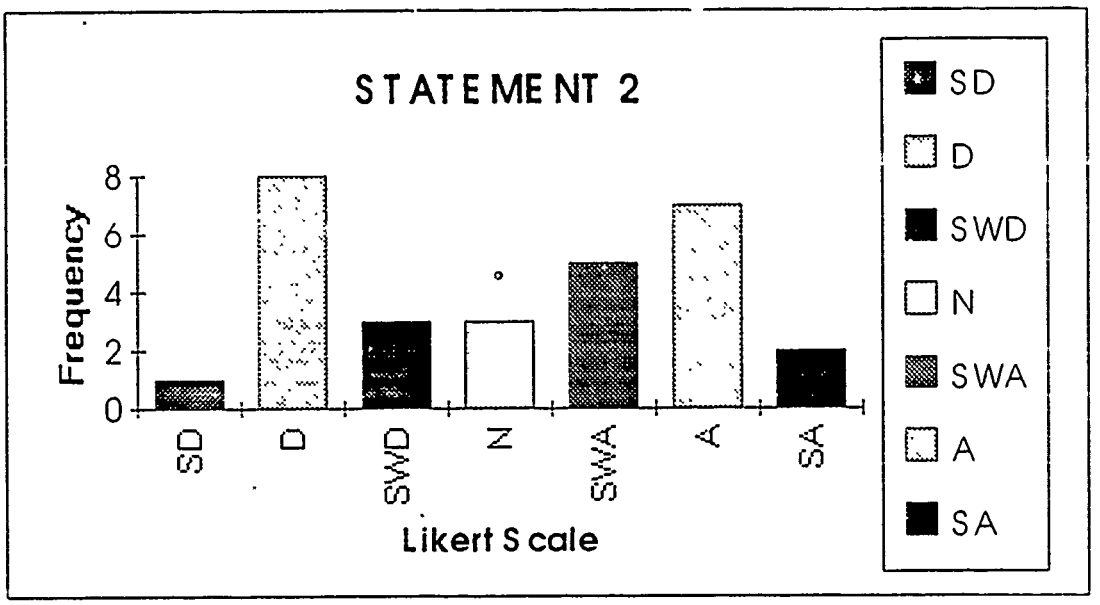

This statement was designed to determine the adequacy of IPT training at the prime contractor. Training has been identified as one of the keys to successful IPT implementation. With 52% of the responses agreeing with this statement, and 45% of the responses disagreeing with this statement, it appears that some individuals on IPTs have received adequate training while others have not. The significant disagreement on this statement would point toward a definite problem with training. This could be the result of new members coming on the team or busy work schedules that do not allow time for training. However, this cannot be determined because when the respondents were asked to give their input for changes to improve their IPT, training was not mentioned by any of the subjects. The response overall indicated that initial training may not be sufficient, that

there may not be an established on-going training program, and that possibly the individual team is responsible for obtaining training for members.

Statement 2.

COMMUNICATION IS BETTER UNDER THE IPT STRUCTURE.

Mean Response: 4.10 (Closest to Neutral)



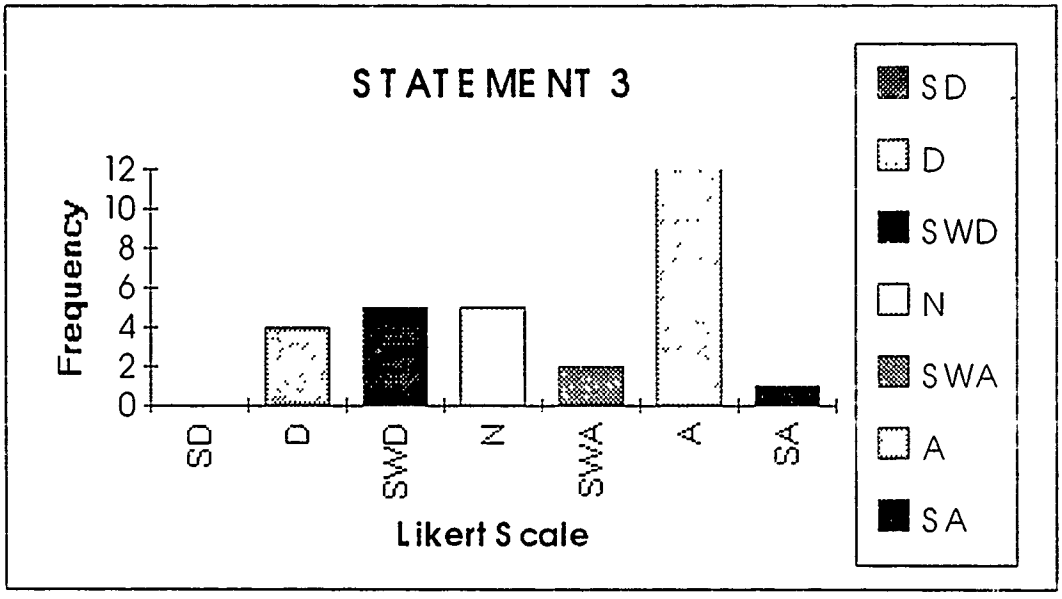

This statement was designed to determine if communications had improved under the IPT concept. Communication is another critical component of successful IPTs. Response to this statement was 48% positive and 41% negative. The nature of the responses suggests that possibly some IPTs are fragmented and that some groups within IPTs communicate more effectively than others. There is also a concern regarding a lack of communication between IPTs and with other contractors and the F-22 SPO. Those contractor personnel that responded positively made no additional comments about the statement. One of the negative respondents had expectations "that IPTs would foster cross-team communication". This respondent did not believe that this had occurred. Another respondent expected improved communication between the Air Force and all

primary contractors but does not feel that communication has improved. Several other respondents believe that communication within their company only occurs from the bottom up and not from the top down. The responses indicate that many of the respondents feel communication has improved with IPTs while almost as many disagree. There have apparently been no clear lines of communications established within, and possibly outside of the IPTs and company.

Statement 3.

THE USE OF IPT STRUCTURE HAS NOT EMPOWERED TEAMS AT THE LOWEST LEVEL TO MAKE DECISIONS.

Mean Response: 4.55 (Closest to Somewhat Agree)




This was the first of the negatively phrased statements designed to determine if IPT teams at this prime contractor have been empowered to make decisions. There were 52% of the respondents that believe their teams were not empowered to make decisions. A fair amount (17%) had no opinion (neutral). The large percentage of positive responses

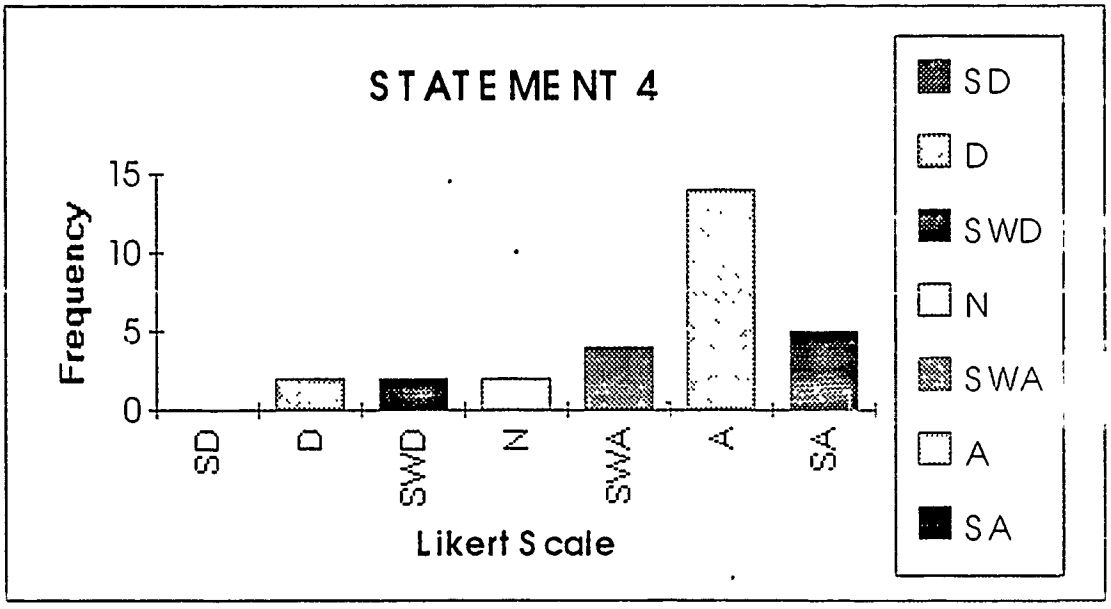
(not empowered) leads the researcher to believe that decisions are made at higher levels and are not an integral part of the IPT process. A response from one individual included, "We have lost sight of the requirement for key decision schedules and continually rework decisions that should have already been made. This undercuts the entire concept of empowerment of IPTs since their efforts are over-ruled from above when decisions are overturned or reworked."

Some of the confusion over empowerment was illustrated by a respondent when the individual stated, "With IPT, its often hard to figure out who can or cannot make a decision. The too frequent result is no decision at all, or a bad compromise." These statements seem to show that there is confusion over where the decision-making authority lies. Although there was a significant number of people who felt they were empowered, none made any comments on the issue. Confusion over empowerment may indicate that all involved people have not fully embraced the IPT concept.

Statement 4.

THE IPT PROCESS IS NOT WORKING AS WELL AS IT SHOULD.

Mean Response: 5.41 (Closest to Somewhat Agree)



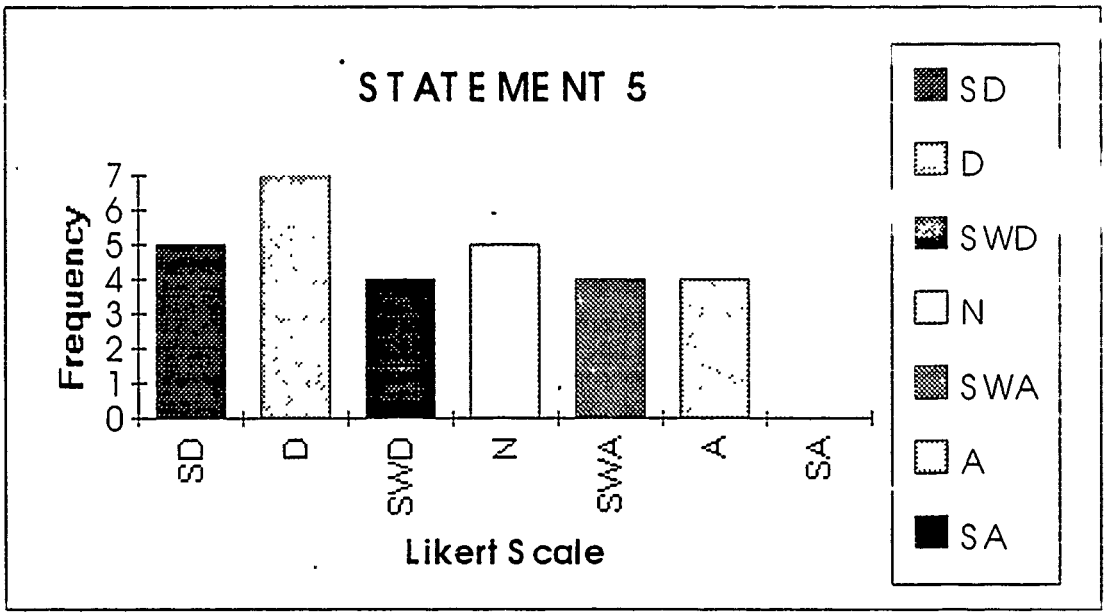

This was a negatively phrased statement designed to determine how prime contractor personnel felt about the success of the IPT process at their site. This statement produced very strong positive responses (IPTs not working as well as they should, 79%) as well as a fair amount of negative responses (14%). There appears to be a common complaint in many of the responses that the traditional functional areas are impeding the IPT's ability to accomplish its tasks. An example of this complaint is contained in one respondents statement that, "There remains a strong functional organization that causes conflicts and gray areas of responsibility." Another respondent similarly said, "IPT leaders report to both functional and program management, both of which often provide conflicting directions. This is why IPT is not better than before." These statements, as

well as others, lead to the inference that functional managers have not fully embraced their roles as advisors but are instead attempting to influence or make decisions at the IPT level.

Statement 5.

THE IPT STRUCTURE IS SET UP IN THE BEST POSSIBLE WAY.

Mean Response: 3.28 (Closest to Somewhat Disagree)



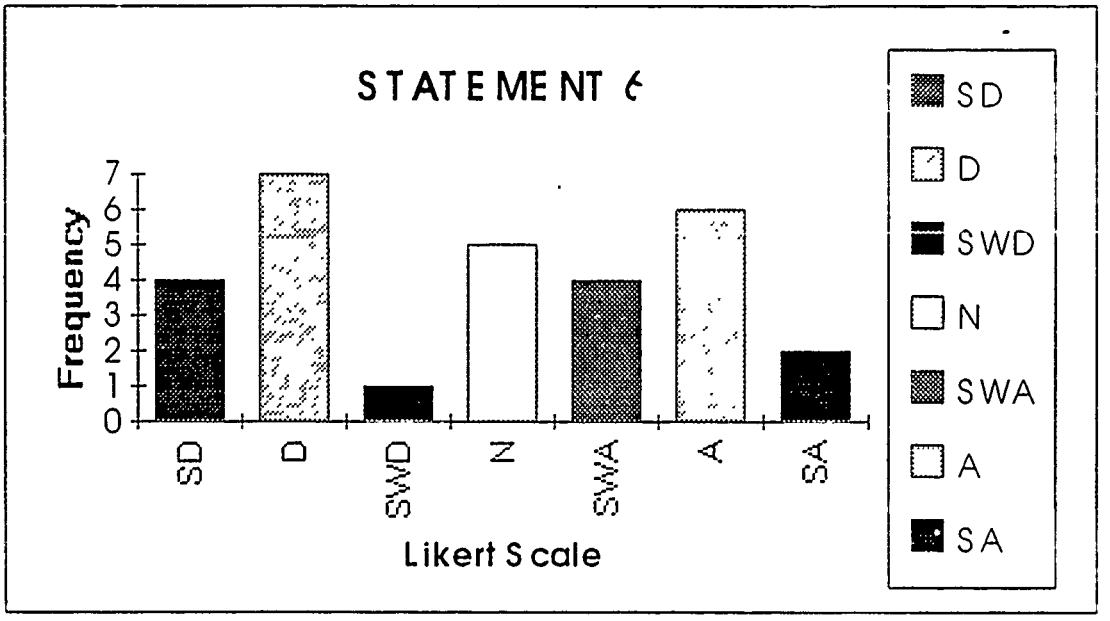

This statement was designed to determine if IPTs at this prime contractor were structured in the best way to achieve company goals. The responses to this statement were 55% negative, 28% positive, and 17% neutral. Many of the respondents did not believe that their company's IPTs were structured properly. The company seems to have established teams that are unnecessary. Several respondents support this statement. One respondent said that there was a "failure to integrate specialty functions (Producibility, Reliability and Maintainability, etc.) within product teams." Many of these non-product areas seem to have established their own IPTs. This is supported by a respondent who

suggested that, "Some functions don't need to be identified individually as IPTs (example: integrity, reliability) but functional members on product teams." Another respondent reiterated this belief when he suggested his company "Remove all IPTs that do not procure a product and incorporate them into actual product teams." The general feeling among respondents seems to be that there are too many teams and that they should be integrated to enhance the process rather than creating impediments. The implication of this is that members are being placed on specialized teams but that these individuals could better utilize their expertise on product related teams. This could significantly speed up the decision-making process and avoid bad decisions made without a complete understanding of the effects of the decision on other areas.

Statement 6.

MANAGEMENT OF THE F-22 PROGRAM IS BETTER DUE TO IPTs.

Mean Response: 3.83 (Closest to Neutral)

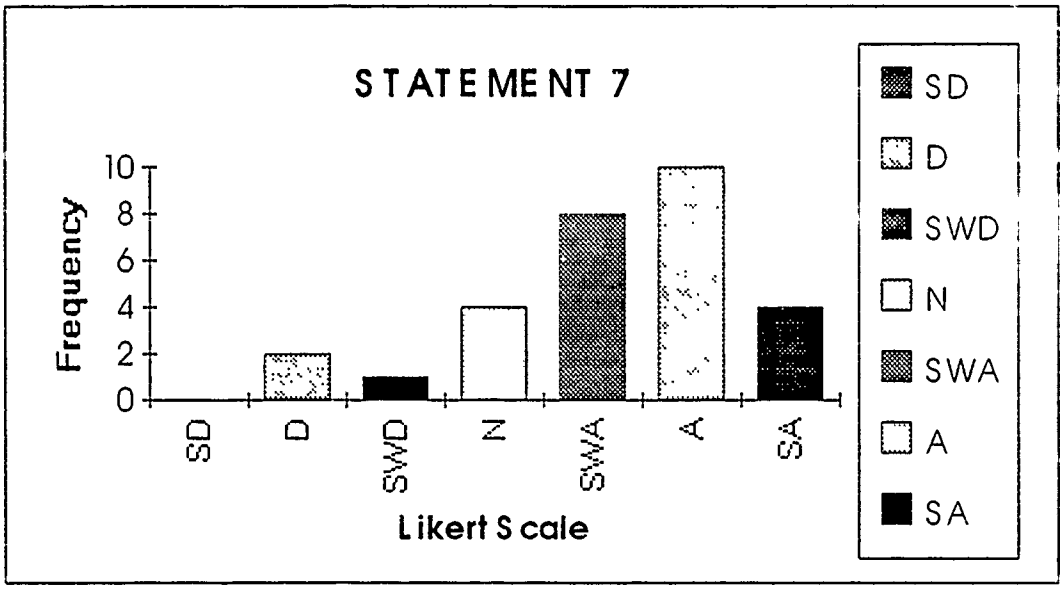


This statement was designed to determine how the IPT structure at the prime contractor has affected the quality of management. The positive and negative responses to this statement were the same at 41%. Those that agreed with this statement made no additional comments. Those respondents that disagreed with this statement had comments such as, "Improve the management structure so that technical and administrative management is more easily understood." Another comment was, "As currently implemented, management has doubled (functional and IPT still exist together)." These comments lead the researcher to believe that the management structure appears confusing and cumbersome to some of the respondents. Again, it seems that the functional managers need a better understanding of their roles as advisors. This could be another indication of the training problem that exists in this company. Better training would clarify the roles and responsibilities of individuals at all levels.

Statement 7.

MANAGEMENT OF THE F-22 PROGRAM IS BETTER DUE TO TECHNOLOGICAL ADVANCES SUCH AS VTC (VIDEO TELECONFERENCING), BETTER COMPUTERS, ETC.

Mean Response: 5.21 (Closest to Somewhat Agree)



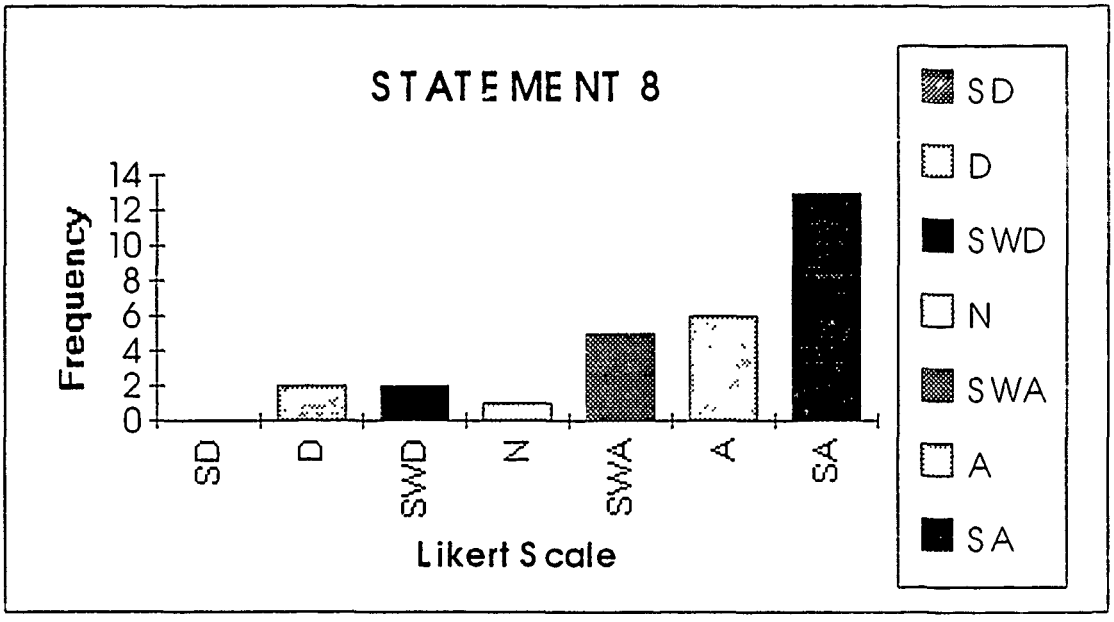

This statement was designed to determine if technological advances such as VTC and better computers have improved management of the F-22 program. This statement produced a largely positive response (76%), with only 11% disagreement. Respondents seem to believe that technology has enhanced management of the program through better coordination and communication capabilities. One respondent stated that there were, "good Electronic Mail links with the SPO." Another suggested that technological advances created "closer coordination with the SPO." Those that disagreed had no specific comments on the statement. These technological advances would be available whether utilizing IPTs or the traditional organizational structure. The response to this statement could indicate that management of the F-22 program has improved as a result of

technological advances rather than better management due to IPT concept implementation.

Statement 8.

THE STRUCTURE OF THE IPTs SHOULD BE THE SAME AT ALL OF THE F-22 COMPANIES.

Mean Response: 5.72 (Closest to Agree)



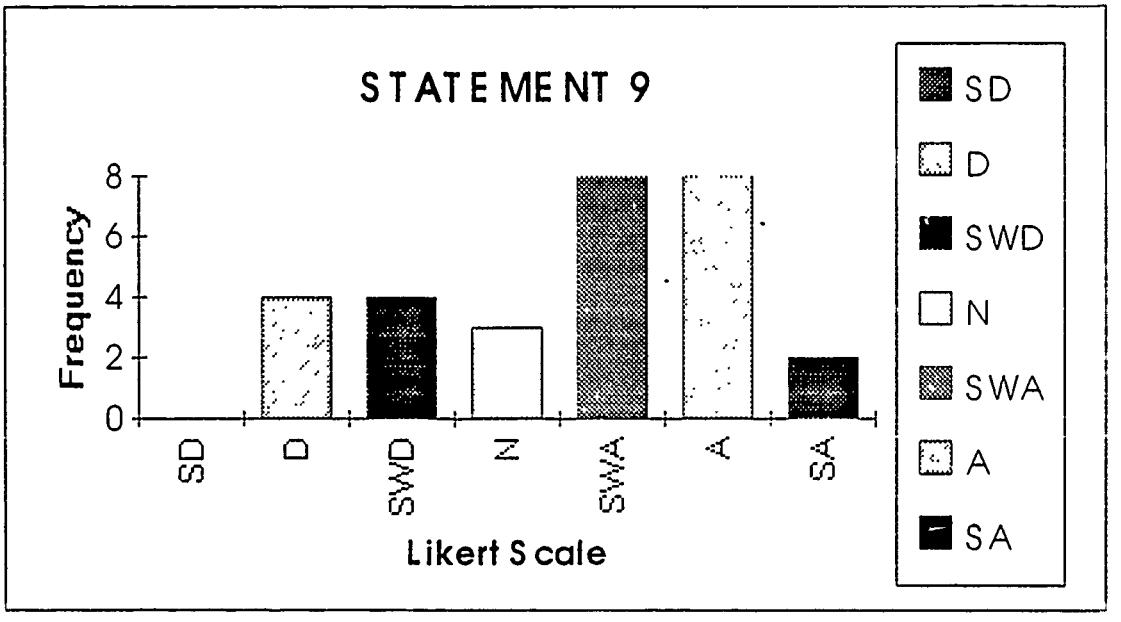

This statement was designed to determine if respondents believed that uniformity of IPTs was important to the F-22 program. The strong positive response to this statement (83%) indicates that most respondents believe that the IPT structure should be the same for all F-22 organizations. When this does not occur, it apparently causes problems such as the problem stated by one respondent who was unhappy because a Tier III manager in his company "arbitrarily reorganized IPT structure contrary to other teams, sites and logic and it foments frustration." It also appears that different IPT structures

would create difficulties with communication and coordination between teams and organizations because there would be no obvious counterpart. There were some who disagreed that team structures should be the same (14%). One respondent stated that team structure "needs to consider the differences in local management organizational structure." It would seem that this individual may not have abandoned the traditional hierarchical management structure.

Statement 9.

MY IPT LEAD MAKES DECISIONS BASED ON TEAM DISCUSSIONS AND CONSENSUS.

Mean Response: 4.28 (Closest to Neutral)



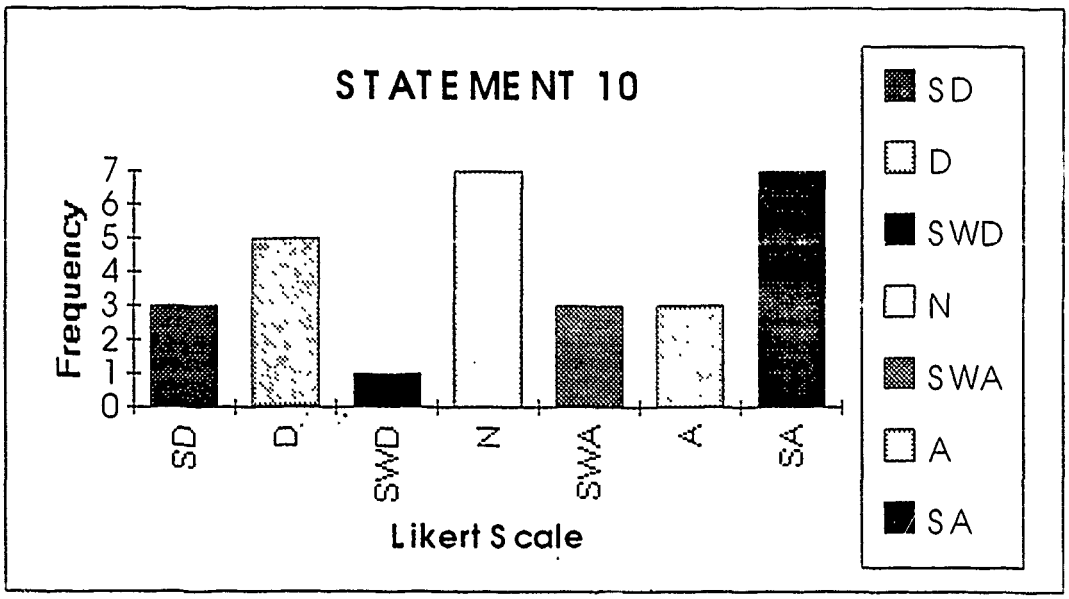

This statement was designed to determine the IPT leader's decision making style. The response to this statement was positive (66%) for the most part. The majority of the respondents felt that their IPT leader valued their opinions when making decisions. It appears that IPTs generally have good communication and teamwork between the leader and members. However, there was significant disagreement on this statement (28%). One

respondent stated, "I think he makes decisions based on his own irrational, nonsensical beliefs alone." Another respondent believes that his "IPT leader is engineering oriented - communicates more and is more partial to engineering functions." While these responses may be somewhat emotional, it appears that in some cases, the IPT leader is not communicating the rationale behind his decisions to all IPT members. Some decisions may be appropriate based upon the circumstances, but if team members are not told why their inputs were not included, they could perceive the team leader as shutting them out of the decision-making process. One of the major tenets of effective IPTs is consensus decision making. If this does not occur, the effectiveness of the IPT will suffer. Training of IPT leaders can greatly enhance their ability to communicate decisions to team members as well as higher levels of management.

Statement 10.

BECAUSE OF IPTs I HAVE A BETTER SYSTEMS PERSPECTIVE THAN ON PAST PROGRAMS.

Mean Response: 4.34 (Closest to Neutral)



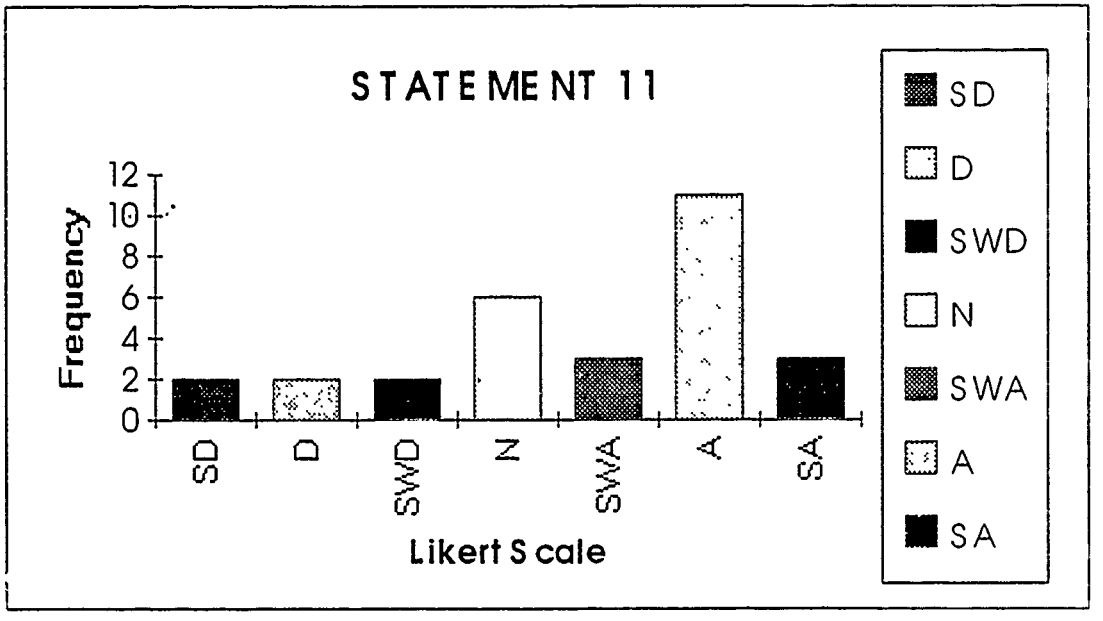

This statement was designed to determine if IPT members were getting a full systems perspective due to their involvement in their IPT. The response to this statement was slightly positive (45%) with significant disagreement (31%) and 24% neutral. Those respondents that gave positive responses were generally strongly in agreement. One individual stated, "Product teams provide an opportunity to work on and understand an entire system not just a portion of it." In this case it seems that the IPT leader and his superiors were making the effort to insure team members knew how they fit into the total scheme of the product. Another individual felt that one of the problems with IPTs was "non-ownership of big picture point of view." This may indicate that some IPT leaders either were not properly trained or do not accept the "total system perspective" element of

the IPT concept. This could cause IPT members and leaders to continue the functional "tunnel vision" approach to product development.

Statement 11.

I ENJOY WORKING ON IPTs MORE THAN IN PREVIOUS ORGANIZATIONAL STRUCTURES.

Mean Response: 4.76 (Closest to Somewhat Agree)



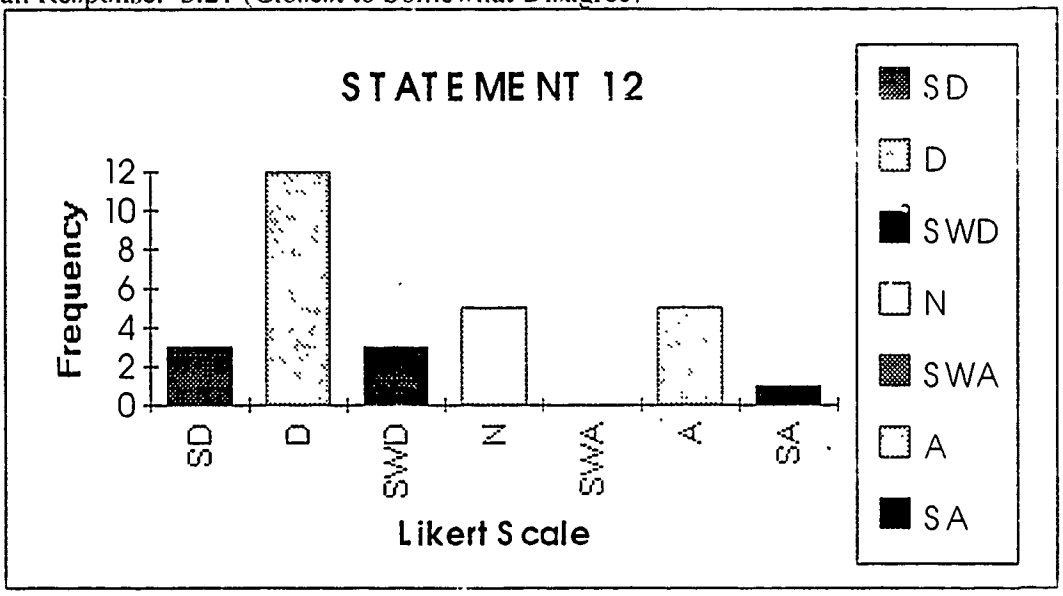

This statement was designed to determine if job satisfaction has improved as a result of IPT participation. The responses to this statement were 59% positive, 21% negative, and 21% neutral. Those individuals who feel productive and believe their IPT is working well, would naturally enjoy their IPT more than the previous organizational structure. Those individuals who disagree with IPTs as they are currently structured and operate within their organization, would most likely prefer the previous organizational structure with which they were familiar and comfortable. There is also a large percentage

of neutral respondents who seem to feel that neither structure, IPT or hierarchical, is satisfying to them. As one respondent stated, "to IPT or not to IPT - doesn't really influence my enjoyment. I'd probably be dissatisfied either way."

Statement 12.

I DO NOT BELIEVE THAT IPTs WILL LEAD TO A BETTER END PRODUCT.

Mean Response: 3.21 (Closest to Somewhat Disagree)




This is the last negatively phrased statement and was designed to determine if the prime contractor personnel believe that IPTs generate an improved product. The positive responses were in the minority at 21%, while the majority of the responses were negative (62%). The majority of respondents believe that IPTs do lead to a better end product. Some responses in support of this are, "I strongly feel that the IPT process is the way to develop an item", and a comment by an individual that IPTs produce a "higher quality product due to increased functional participation and ownership." It would seem that those individuals that have embraced the IPT concept believe that IPTs are a better way to produce their product.

Summary

This F-22 prime contractor is having difficulty fully implementing the IPT process. There seems to be resistance to the IPT concept. The contractor, although structured similar to the F-22 SPO, is utilizing teams that are not direct producers of a product and has not clearly defined the roles of the functional directorates. Communication could be improved within and among IPTs as well as outside of the company. Most IPT members agree that technological advances, such as video teleconferencing and improved computers, have aided management of the program but IPT members are split on whether management itself has improved since implementing IPTs. The initial training provided for IPT implementation appears to be adequate, however initial training could be improved and there does not appear to be an on-going training program. The majority of IPT members do not believe they are empowered to make decisions. There seems to be a problem with top-down communication to let IPT members know why decisions are over-turned or changed. Generally, IPT members seem to believe that if the above mentioned concerns are addressed, the company's IPT process would work well.

From the results of the analysis, the main areas for emphasis at this prime contractor should be to ensure proper composition of teams and improve communication within and among teams. Improved training would significantly enhance IPT implementation. IPT leaders and management should respect team decision and use the expertise team members possess.

# V. Conclusions and Recommendations

## Introduction

The manner in which Department of Defense guidelines and policies are implemented for acquisition programs is changing. The declining defense budget and increased scrutiny of government spending has changed the DODs way of developing and acquiring new weapons systems.

The structure of organizations responsible for acquiring new systems is changing to emphasize minimizing cost, improving scheduling, improving performance, and improving product quality throughout the product's life cycle. To maximize the impact of these changes, DOD major acquisition agencies are abandoning the traditional functional approach for a product team approach.

Based on previous studies and discussions, it appears that the F-22 SPO has successfully implemented the IPT structure. Within DOD, the F-22 program was the first selected to prototype the product team style of management. Because of the required close coordination between the F-22 SPO and the prime contractors during acquisition of the weapon system, the prime contractor IPTs were good candidates for analysis of the effective implementation of the IPT concept.

## Findings

The survey findings indicate that there are significant problems with the way this F-22 prime contractor has implemented the IPT concept. While most respondents agree that IPTs, if properly formed and empowered, produce a better product, over three fourths of the personnel at this prime contractor site believe that the IPT process is not working as it should in this company. Many of the respondents believe that the problem is caused by the traditional functional areas refusing to accept the IPT philosophy. Another problem

with IPTs in this company is caused by the perception that there is no respect for lower tier decisions. Many IPT members complained about decisions being over-turned or re-worked or their inputs being ignored.

Nearly one half of the respondents indicated that there are communication problems within and between company IPTs, as well as with F-22 organizations outside of their company. Many also believe that there is little or no top-down information flow within the company. Respondents feel this isolates team members from a total system perspective. These communication problems restrict the flow of information on key issues, affecting the decision-making process throughout the program.

Another problem identified by the majority of respondents was inadequate training. This can seriously degrade an IPTs ability to achieve its established goals. Over one third of the respondents do not believe that program management has improved as a result of IPTs. In addition, almost one third do not believe their IPT leaders make decisions based on team discussion and consensus. There may be reasons why a team leader makes independent decisions, but these reasons should be made known to team members. Again, nearly one third of the respondents do not believe their systems perspective has improved over past programs. This indicates a management and communication problem.

Implications

Overall, it appears that this prime contractor is having significant difficulty enabling the necessary cultural change to implement the IPT concept. The company, although organized similar to the F-22 SPO organization, has not clearly defined the roles of the functional areas and the IPTs. It is possible that many of the problems identified are the result of faulty perceptions by company IPT members. But whether perceived or real, the problems exist in the minds of the IPT members surveyed and must be addressed.

The product team organizational structure does not appear to have improved the ability of this company's personnel to contribute to the success of the F-22 program and their specific end product. Although the majority of respondents agree that IPTs lead to a better end product, responses to other statements in the survey indicate they do not believe IPTs are working in their company.

The company is having a problem defining and separating the responsibilities of the functional areas and the IPTs. This has led to a "too many bosses" feeling of survey respondents and conflicts caused by territorial disputes. Improved communication and training would help alleviate this problem.

IPT training is a major problem with 48% of the respondents believing they are inadequately trained. An improved initial training program and an on-going training program would help solve many of the problems identified in other areas of IPT implementation.

Although 48% of the respondents feel that communication has improved since instituting IPTs, 41% disagree. This response pattern would indicate a definite need to improve communications at this prime contractor. Top-down communication, intra-team communication, and inter-team communication were all identified as problems and should be addressed by management.

A significant number of respondents (41%) do not believe their IPT structure is set up in the best possible way. The company employs IPTs made up entirely of non-product producing functions (Reliability & Maintainability, Producibility). These individuals should be disbursed into the product related IPTs where their expertise could be used to resolve issues before they become problems.

Over one fourth of the respondents felt that IPT leaders in their company did not involve them in decision making. This management style by team leaders may negatively influence team commitment and ultimately undermine the team concept. This problem

goes along with the perception that decisions are over-ruled from above. This could ultimately destroy the whole IPT concept within the company.

Recommendations

Results of this research indicate that the prime contractor has significant problems with IPT implementation. Recommendations for improvements will focus on company management, functional area management, team leadership, training, and communication flow. Table 2 lists specific recommended actions for the contractor.

| Table 2. Summary of Recommendations |
| --- |
| 1. Establish commitment to product teams.<br>2. Clearly define responsibilities for functional managers and IPTs.<br>3. Establish a two way information flow.<br>4. Stop IPT leaders from reporting directly to functional managers.<br>5. Establish consensus decision-making process.<br>6. Improve initial IPT training.<br>7. Establish on-going IPT training program.<br>8. Establish formal communication paths. |

Company management has not firmly established its commitment to product teams. Company management should clearly define the responsibilities of functional area managers and IPTs. They should also develop a means to flow pertinent information to the lowest levels to instill a whole system perspective in their IPTs. These areas can be improved by establishing clear lines of communication and developing a comprehensive training program.

The second area of concern is functional area management. Functional area managers should be acting in a capacity as advisors and supporting agencies to upper management. Attempting to influence or make decisions for IPTs may produce conflicts and could be counterproductive to achieving company goals. IPT leaders should not be

reporting directly to functional area managers as well as product managers. This leads to conflicting directions and frustration for team leaders and team members.

The third area of concern involves team leadership. The biggest problem seems to be communication which is one of the essential skills of a team leader identified in Chapter II. A significant number of team members believe that decisions are being made by team leaders without their input, or that upper levels of management ignore or arbitrarily change their decisions. This belief by team members can undermine team integrity. Team leaders should communicate to the team on the progress of critical issues, explain the management rationale behind reversed decisions, and work very hard to keep team integrity intact. Specific training should be provided to teach the skills necessary to be an effective team leader. There are many writings on team building that can assist team leaders.

The fourth area of concern is inadequate training. Improved training would help solve some of the other problems areas identified by IPT members. The roles and responsibilities of functional area managers and IPTs could be clearly defined through comprehensive training. Communication paths could be explained during training so team members would know what is available and how to use it. Team building, Total Quality Management, and team leader training should be covered during initial training and reinforced throughout an on-going training program. Comprehensive training is a cornerstone of successful IPT implementation.

The last concern is communication flow. Communication paths must be formally established. Each team member will be most effective when communication flow is frequent and effective. This can be accomplished through video and telephone teleconferencing, computer communications systems, and face-to-face communications. Specifically, each team member should understand the communication flow from the top

down and the bottom up, as well as between and among IPTs. Again, a training program could help team members understand the company's communications flow.

Other DOD and contractor programs could be encountering similar problems to those identified in this study and may be able to avoid some of the problems encountered by this prime contractor. For this reason, the researcher recommends this survey be provided to emerging product teams or product teams that are experiencing difficulty with IPT implementation. This would allow, in some cases, early identification and possible simpler remedies for the types of problems this prime contractor has experienced.

## Follow-On Research

There are several opportunities for follow-on research including case studies of other F-22 prime contractors and other acquisition programs employing the IPT concept. Many organizational issues would be the same as presented here regardless of the size of the program. The researcher believes that any product team could benefit from this study. By studying this research, product teams can determine what improvements can be made within their IPT or organization as well as avoiding potential problem areas by addressing them early in the implementation process.

## Conclusion/Summary

There are significant problems with the way the prime contractor has implemented IPTs. Refusal to accept the cultural change that accompanies successful IPT implementation is a root cause for many of the problems experienced by this company. Problems associated with training and communication have seriously degraded the ability of product teams to effectively perform their assigned tasks.

Management emphasis to enable the necessary cultural change will significantly improve IPT effectiveness within their company. Improved training and communication

will also solve many of the problems encountered by this prime contractor while implementing IPTs.

Appendix A

11 May 94

MEMORANDUM FOR: (contractor name removed for confidentiality)

SUBJECT: Survey on Integrated Product Teams (IPTs)

The attached survey seeks your opinions and experiences with the current F-22 IPT structure and operation. Your response and the results will help me complete a research paper on Integrated Product Development. Although your input is strictly **voluntary and anonymous**, it is an opportunity to express your concerns and ideas for future programs that will utilize the IPT structure. Your opinions and experiences are important and I thank you in advance for your time and comments.

//signed//
David E. Freeman, Capt, USAF
F-22 System Program Office
EPS/H&I IPT

# INTEGRATED PRODUCT TEAM SURVEY

PURPOSE: The purpose of this survey is to identify strengths and weaknesses in the current IPT structure. It is an anonymous survey and will provide statistical data and opinions that will enable me to complete a thesis.

INSTRUCTIONS:

1. Please answer every item.

2. Answer all items according to your initial reaction and circle the most appropriate answer.

3. Some items ask for your opinion. There are no right or wrong opinions. I want to know how you view your IPT.

4. Do not put your name on the survey.

5. This survey should take only 15-20 minutes.

6. Once you have completed the survey, return it to (Names removed for confidentiality).

7. Please try to complete the survey by 20 May 94 or sooner. Your expedience will be appreciated.

Present Job Title: _____

Years of Experience on aircraft programs: _____

1. I received adequate training on how the IPT concept works.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

2. Communication is better under the IPT structure.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

3. The use of IPT structure has not empowered teams at the lowest level to make decisions.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

4. The IPT process is not working as well as it should.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

5. The (contractor name removed for confidentiality) IPT structure is set up in the best possible way.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

6. Management of the F-22 program is better due to IPTs.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

7. Management of the F-22 program is better due to technological advances such as the VTC, better computers, etc.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

8. The structure of the IPTs should be the same at all of the F-22 companies.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

9. My IPT lead makes decisions based on team discussions and consensus.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

10. Because of IPTs, I have a better systems perspective than on past programs.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

11. I enjoy working on IPTs more than in previous organizational structures.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

12. I do not believe that IPTs will lead to a better end product.

| STRONGLY DISAGREE | DISAGREE | SOMEWHAT DISAGREE | NEUTRAL | SOMEWHAT AGREE | AGREE | STRONGLY AGREE |
|---|---|---|---|---|---|---|

13. What were your expectations of IPTs during their establishment (pros/cons)?

14. What are your biggest issues/concerns with IPTs?

15. What benefits do you see that are related to IPTs?

16. What would you change in the current IPT structure to improve it?

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# Vita

Ms Stephanie Lopez graduated from St. Mary's University in Dec 1989 with a Bachelors degree in Management Information Systems from the School of Business Administration. Her first assignment was at HQ AFMC as the DO41 Central Secondary Item Stratification (CSIS) acting OPR. She was then transferred to the Supply Branch to assist during Desert Storm. She then spent approximately one year TDY to OC-ALC, Supply Officers School, and DOD Inventory School. After returning to HQ AFMC, she was assigned to the Two Level Maintenance office where she was selected as the Coronet Deuce III project officer. She later moved to the Lean Logistics office as a project officer. Her present position is a system analyst at HQ AFMC. She is currently pursuing a Master Degree at AFIT as a part time student. Her current address is:

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This research investigates the effects of implementating the Integrated Product Development (IPD) philosophy in a major acquisition program, specifically an F-22 Advanced Tactical Fighter Prime Contractor's IPD implementation. The population of the study consists of employees of the prime contractor working directly with IPTs on the F-22 program. A survey with closed-ended questions and open-ended statements was used to collect data. The survey was pretested on F-22 SPO personnel to increase survey reliability. Survey results indicate that this prime contractor is having difficulty implementing IPTs. The IPT structure in this company does not seem to have improved the ability of company personnel to contribute to the success of the F-22 program. Research indicates that the company should firmly establish its commitment to product teams and clearly define the roles of functional area managers and IPTs. Team leaders could better communicate with team members about critical issues and decisions. Improved training could alleviate many of the company's problems implementing IPTs. Finally, communication should improve. IPTs can be most useful when communication is frequent and effective.

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